

CLAIMS

What is claimed is:

1. A method for stacking cases on a pallet, the method comprising the steps

5 of:

supplying cases to a buffer;

defining rules for selecting a case from the buffer to be placed on the pallet;

determining physical characteristics of cases in the buffer including dimensions of a case base and a case height;

10 determining available positions on the pallet where a case in the buffer can be placed on the pallet;

using physical characteristics of cases in the buffer and applying the rules to at least a portion of the buffer cases;

15 identifying a selected buffer case that satisfies at least one of the rules and a corresponding position on the pallet for the selected case; and

using an industrial robot to place the selected case on the pallet at the corresponding position.

2. The method of claim 1, further comprising:

20 determining the rule that identified the last selected buffer case that was placed on the pallet; and

reapplying the determined rule before applying another rule to a buffer case.

3. The method of claim 1, wherein the step of identifying a selected case
25 and a corresponding position for the selected case to be placed on the pallet further comprises:

applying the rules to cases in the buffer and the available positions;

identifying the buffer cases and the corresponding positions that satisfy at least one rule;

establishing factors related to the quality of the pallet stack that would result by placing a buffer case on the pallet;

determining a relative importance of each factor;

using the factors and their relative importance to determine from the identified

5 buffer cases a selected buffer case and corresponding position having the highest weighted best score;

placing the selected buffer case having the highest weighted best score in the corresponding position on the pallet.

10 4. The method of claim 1, wherein the step of identifying a selected case and a corresponding position for the selected case further comprises:

determining a first measure of the stability of a tower of cases on which the selected case would be placed in the position;

comparing the first measure of stability to a stability standard; and

15 placing the selected case on the pallet in the corresponding position provided the first measure of stability meets or exceeds the stability standard.

5. The method of claim 1, wherein the step of identifying a selected case and a corresponding position for the selected further comprises:

determining a first measure of the stability of a tower of cases on which the selected case would be placed in the position;

determining a second measure of the stability of the selected case when placed in the corresponding position on the pallet;

20 comparing the first and second measures of stability to respective stability standards; and

25 placing the selected case on the pallet provided the first and second measures of stability meet or exceed the respective stability standards.

6. The method of claim 1, wherein the step of identifying a selected buffer case and a corresponding position where the selected case can be placed on the pallet further comprises:

5 determining a distance between a center of mass of a tower of cases stacked on the pallet that would include a buffer case that satisfies one of the rules and an edge at a base of said tower;

determining a height of said tower from the base;

10 using said distance and said height to determine a magnitude of a horizontal component of acceleration at the center of mass of the tower that would destabilize the tower when the tower is supported along said edge; and

comparing the horizontal component of acceleration to an acceleration standard;

15 placing the selected case on the tower provided the horizontal component of acceleration meets or exceeds the acceleration standard.

7. The method of claim 1, wherein the step of identifying a selected buffer case and a corresponding position where the selected case can be placed on the pallet further comprises:

20 determining a distance between a center of mass of an identified buffer case that satisfies one of the rules and an edge at the base of said identified buffer case;

determining a height of said identified buffer case from the base of said identified buffer case;

25 using said distance and said height to determine a magnitude of a horizontal component of acceleration at the center of mass of said identified buffer case that would destabilize said identified buffer case when supported along said edge; and

comparing the horizontal component of acceleration to an acceleration standard;

placing the selected case on the pallet in the corresponding position provided the horizontal component of acceleration meets or exceeds the acceleration standard.

8. The method of claim 1, wherein the step of identifying a selected case and a corresponding position for the selected case to be placed on the pallet further comprises:

- 5 applying the rules to cases in the buffer in relation to the available positions;
- identifying the buffer cases and the corresponding positions that satisfy at least one rule;
- determining a measure of the stability of respective towers of cases on which the identified cases would be placed in the corresponding positions;
- 10 comparing the measure of stability of each identified buffer case to determine a selected buffer case having the highest measure of stability; and
- placing the selected buffer case on the tower in the corresponding position.

9. The method of claim 1, wherein the step of determining available 15 positions on the pallet where a buffer case can be placed further comprises:

- continually updating available regions on the pallet where a buffer case can be placed as cases are placed on the pallet; and
- continually replenishing the buffer with cases after a buffer case is placed on the pallet.

20 10. A method for stacking cases on a pallet, the method comprising the steps of:

- supplying cases to a buffer;
- defining a rules for selecting cases from the buffer to be placed on the pallet;
- 25 determining physical characteristics of cases in the buffer including dimensions of a case base and case height ;
- determining available locations on the pallet where a buffer case can be placed;
- applying the rules sequentially in a variable prioritized order to at least a portion of the buffer cases and the avail locations;

identifying a selected case that satisfies at least one of the rules and a corresponding location on the pallet for the selected case; and

using an industrial robot to place the selected case on the pallet in the corresponding location.

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11. The method of claim 10, further comprising:

repeatedly applying the rules in a variable prioritized order to the buffer cases;

repeatedly selecting for placement on the pallet a case that satisfies a rule; and

repeatedly placing each case on the pallet in the corresponding location until

10 the platform is filled with cases;

supplying an unfilled pallet; and

continually replenishing the buffer with cases after a buffer case is placed on the pallet.

15 12. The method of claim 10, further comprising:

determining the rule that was satisfied by the last selected buffer case that was placed on the pallet; and

reapplying the determined rule before applying another rule to a buffer case.

20 13. The method of claim 10, wherein the step of identifying a selected case and a corresponding location for the selected case further comprises:

applying the rules to cases in the buffer;

identifying the buffer cases that satisfy at least one rule and the corresponding location for the identified case;

25 establishing factors related to the quality of the pallet stack that would result by placing a buffer case on the pallet;

determining a relative importance of each factor;

using the factors and their relative importance to determine from the identified buffer cases a selected buffer case and corresponding location having the highest weighted best score;

5 placing the selected buffer case having the highest weighted best score in the corresponding location on the pallet.

14. The method of claim 10, wherein the step of identifying a selected case and a corresponding location for the selected case further comprises:

10 determining a first measure of the stability of a tower of cases on which the selected case would be placed in the location;
comparing the first measure of stability to a stability standard; and
placing the selected case in the corresponding location pallet provided the first measure of stability meets or exceeds the stability standard.

15. The method of claim 10, wherein the step of identifying a selected case and a corresponding location for the selected case comprises:

determining a first measure of the stability of a tower of cases on which the selected case would be placed in the location;
determining a second measure of the stability of the selected case when placed 20 in the corresponding location on the pallet;
comparing the first and second measures of stability to respective stability standards; and
placing the selected case in the corresponding location provided the first and second measures of stability meet or exceed the respective stability standards.

25 16. The method of claim 10, wherein the step of identifying a selected buffer case and a corresponding location comprises:

determining a distance between a center of mass of a tower of cases stacked on the pallet that would include an identified buffer case and an edge at a base of said tower;

determining a height of said tower from the base of said tower;

5 using said distance and said height to determine a magnitude of a horizontal component of acceleration at the center of mass of the tower that would destabilize the tower when the tower is supported along said edge; and

comparing the horizontal component of acceleration to an acceleration standard;

10 placing the selected case on the tower provided the horizontal component of acceleration meets or exceeds the acceleration standard.

17. The method of claim 10, wherein the step of identifying a selected buffer case and a corresponding location where the selected case can be placed on the pallet further comprises:

determining a distance between a center of mass of an identified buffer case that satisfies one of the rules and an edge at the base of said identified buffer case;

determining a height of said identified buffer case from the base of said identified buffer case;

20 using said distance and said height to determine a magnitude of a horizontal component of acceleration at the center of mass of said identified buffer case that would destabilize said identified buffer case when supported along said edge; and

comparing the horizontal component of acceleration to an acceleration standard;

25 placing the selected case on the pallet in the corresponding location provided the horizontal component of acceleration meets or exceeds the acceleration standard.

18. The method of claim 10, wherein the step of identifying a selected case and a corresponding location for the selected case to be placed on the pallet further comprises:

applying the rules to cases in the buffer in relation to the available locations;

5 identifying the buffer cases and the corresponding locations that satisfy at least one rule;

determining a measure of the stability of respective towers of cases on which the identified cases would be placed in the corresponding locations;

10 comparing the measure of stability of each identified buffer case to determine a selected buffer case having the highest measure of stability; and

placing the selected buffer case on the tower in the corresponding location.

19. The method of claim 10, wherein the step of determining available locations on the pallet where a buffer case can be placed further comprises:

15 continually updating available regions on the pallet where a buffer case can be placed as cases are placed on the pallet.